Cell Biology Learning Games Final report

CSCE 606 Software Engineering

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1 Summary

Cell Biology Learning games are educational games designed for the reinforcement of biology concepts for high school students. These games are designed so that the students learn biology concepts with fun and encourage them to learn more without going through any tiresome processes.

Our customer for this project is the Veterinary Medical & Biomedical Sciences Department of Texas A&M University. Torri Whitewalker is the representative, a content specialist for the Peer (Partnerships for Environmental Education and Rural Health) Program. During this project, Dr. Hank Walker was our primary point of contact from the customer side. We developed and deployed games on the StepStone learning environment, a powerful web-based content authoring environment designed by The Center for Educational Technologies, Texas A&M. This is the part of the Peer Program's One Health curriculum. This environment efficiently produces compelling and effective learning experiences that work on any device with the internet.

Our team focused on the Cell Biology Module, part of the many other modules, namely Stress, Infectious Diseases, Ecology, and Clinical Trials. We were given a set of slides covered by the module and a list of animations/games requested by Torri Whitaker. We were responsible for implementing games, animations, and deployment for the Cell Biology Module. We also created data files for the different modules. We implemented the animations using *HTML5, standard CSS, and basic JavaScript*.

Previous teams working on this project created and successfully deployed two games – *Guess-Up* and *Scramble*. Our requirement for the project was to enhance the existing games, create a new game, test them, and successfully deploy the changes in the StepStone environment. In the Guess-Up game, we added a few changes like making lives dynamic based on the word's length; earlier, it was a constant value of 10. Other than that, we added difficulty levels and randomness in the appearance of images/questions on a new game load. Previously the same question/images appeared every time the game started. In the Scramble game, we enhanced the game's intuitiveness/responsiveness, like removing the text selection cursor on tiles, normalizing

the size, and only permitting the tiles' horizontal movement. Our new game, called the *Quiz Game*, is a game that consists of a set of biology questions. To win the game, students have to answer the questions correctly until it reaches the endpoint. We also implemented the necessary animation for the Quiz Game.

We followed Agile software development methodology; we created user stories that reflected the customer's requirements such as animations issues, quality of life improvements, enhanced user experience, etc. For each iteration, we implemented these changes locally and updated our code repository on GitHub. After substantial changes, we deployed it on the StepStone environment with the help of the developer Daniel Shuta. The final video for the poster and demo can be found on YoutTube. In this final report, we have added a section that serves as a tutorial to deploy the code on the StepStone environment.

2 Development and Management

2.1 BDD/TDD

We started with exploring Jasmine for unit testing of legacy code, which took time to integrate legacy code with the jasmine environment. However, we did not proceed with the complete testing as that required writing test cases for the legacy code from scratch. As customer priority was more on the development of a new game, we decided to proceed with the development part instead of unit testing legacy code. We used Pivotal Tracker to codify our user stories, this provided guidance in game development that reflected the customer requirements.

2.2 Configuration Management

We configured our code management with a few releases and one branch because each user story we implemented was completely modular and separate from all other stories. With one branch and two releases, it was easy to manage our project. Each release contained all progress towards completing our user stories as of the end of the corresponding iteration. We didn't have any spike in the project.

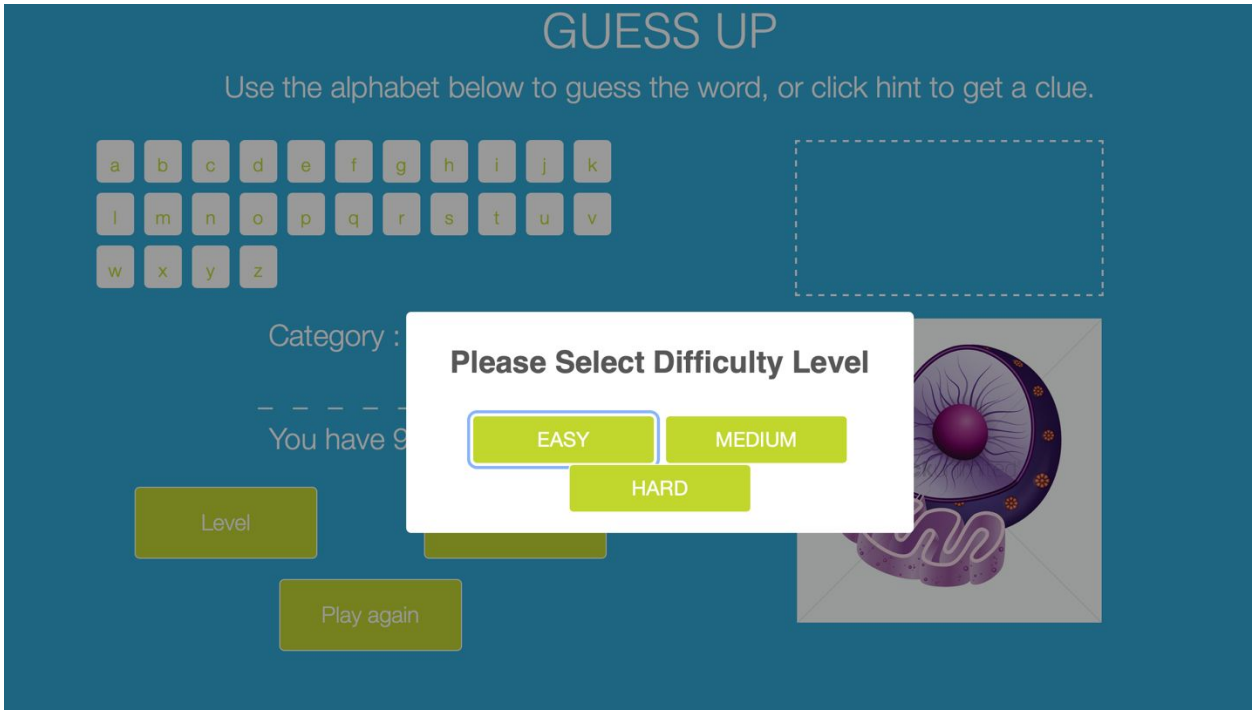
3 User Stories

3.1 User stories related to the Guess Up game.

3.1.1 User story: Add a difficulty setting to the Guess Up game.

Points: 1. Status: Complete. Description: As a player, I want to select from the difficulties: easy, medium, and hard, so that I can be given words that appropriately match my knowledge.

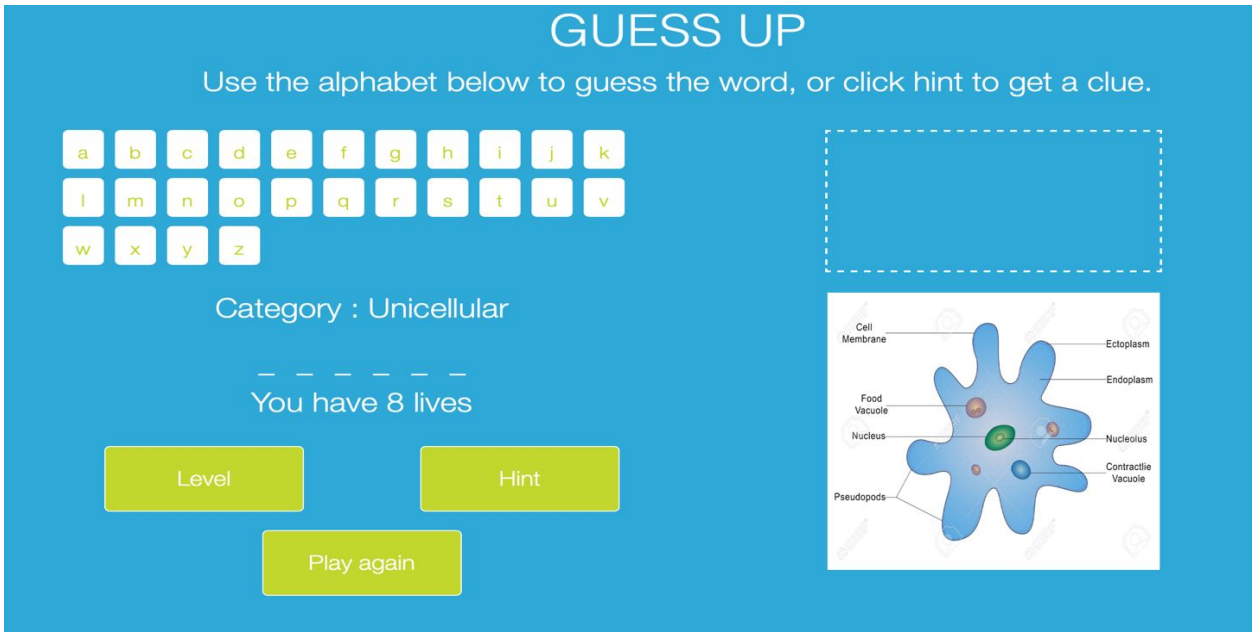
In the existing Guess-Up game code, we added a new button "level" with difficulty levels: easy, medium, and hard. Words appear based on the difficulty level selected by the player.



3.1.2 User story: Use a dynamic number of lives.

Points: 2. Status: Complete. Description: As a player, I want the number of lives to be based on the difficulty of the word and the difficulty setting.

We made the changes to the existing code of the Guess-Up game so that instead of a constant number of lives 10, dynamic numbers of lives appear for different words based on their difficulty level.

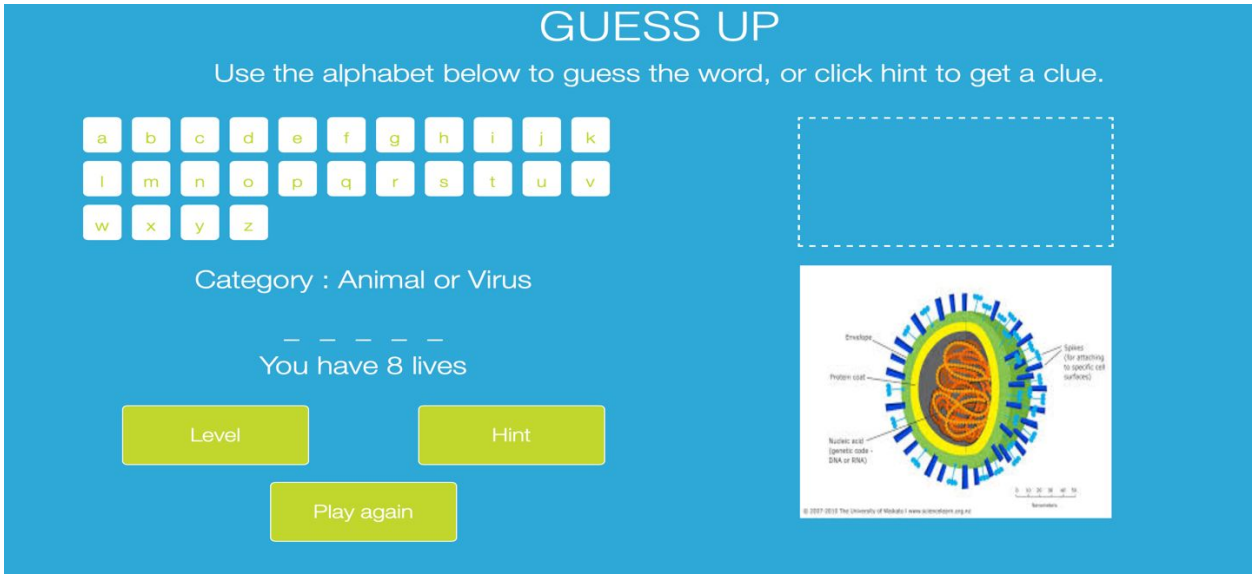


3.1.3 User story: Introduce randomness into Guess Up.

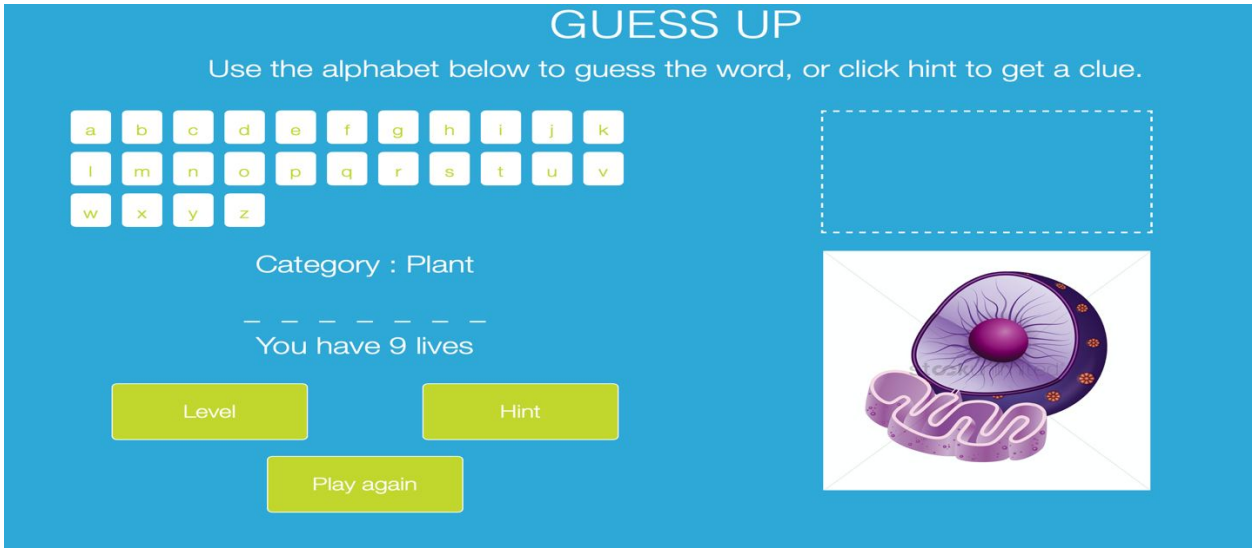
Points: 2. Status: Complete. Description: As a player, I want the words to be given to me in random order.

In the existing code of the Guess-Up game, we made the changes to add randomness in the appearance of words on every new game load. Previously the same word appeared every time the player started the game.

The game was loaded for the first time.



The game loaded a second time.



3.2 User stories related to the Scramble.

3.2.1 User story: Remove text selection cursor on tiles in Scramble.

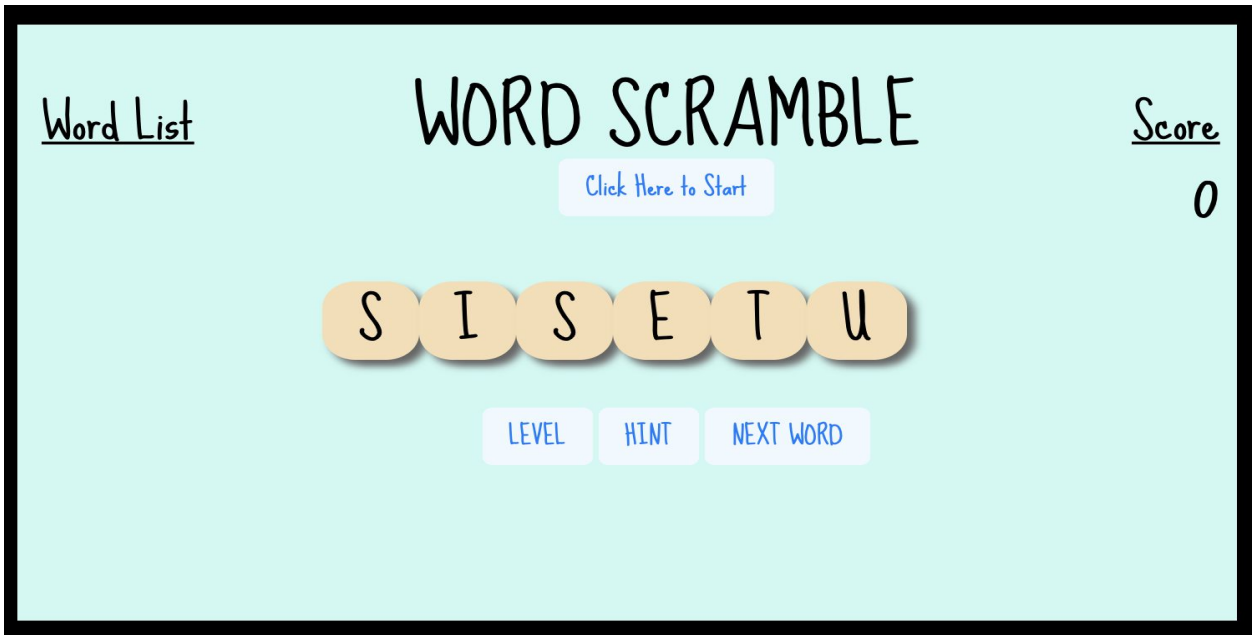
Points: 2. Status: Complete. Description: As a player, I do not want to see the text selection cursor while clicking and dragging tiles.

In the existing code of the scramble game, we made the changes so that the text selection cursor does not appear while clicking and dragging the tiles to arrange them.

3.2.2 User story: Normalize tile size in Scramble.

Points: 2. Status: Complete. Description: As a player, I want each tile of a given Scramble word to have the same size.

We made the changes in the existing code of Scramble so that each tile of the scramble word has the same size. Previously tiles for some letters were different in size.



3.2.3 User story: Only permit horizontal movement in Scramble.

Points: 3. Status: Complete. Description: As a player, I only want to be allowed to move a tile horizontally.

In the existing code of scramble game, we made the changes so that the tiles of letters are allowed to be moved only horizontally while arranging the word. Earlier the tiles could be moved anywhere on the screen.

3.3 User stories related to the Quiz game.

3.3.1 User story: Implement user friendly style for quizGame with CSS and HTML.

Points: 1. Status: Complete. Description: As a player, I should find the user interface clear and easy to use.

3.3.2 User story: Set up a page structure for quizGame with one question per page.

Points: 2. Status: Complete. Description: As a player, I should only be asked one question at a time.

3.3.3 User story: Implement multiple choice question interface for quizGame.

Points: 2. Status: Complete. Description: As a player, I want to be able to select the option that best answers the question.

3.3.4 User story: Display results for quizGame.

Points: 1. Status: Complete. Description: As a player, I want to see whether I got each question correct or incorrect.

3.3.5 User story: Implement content template for quizGame.

Points: 2. Status: Complete. Description: As a game administrator, I want to easily be able to add new questions to quizGame.

3.3.6 User story: Implement scoring and win/loss conditions for quizGame.

Points: 2. Status: Complete. Description: As a player, I want the game to keep track of my score and decide whenever I have won or lost the game.

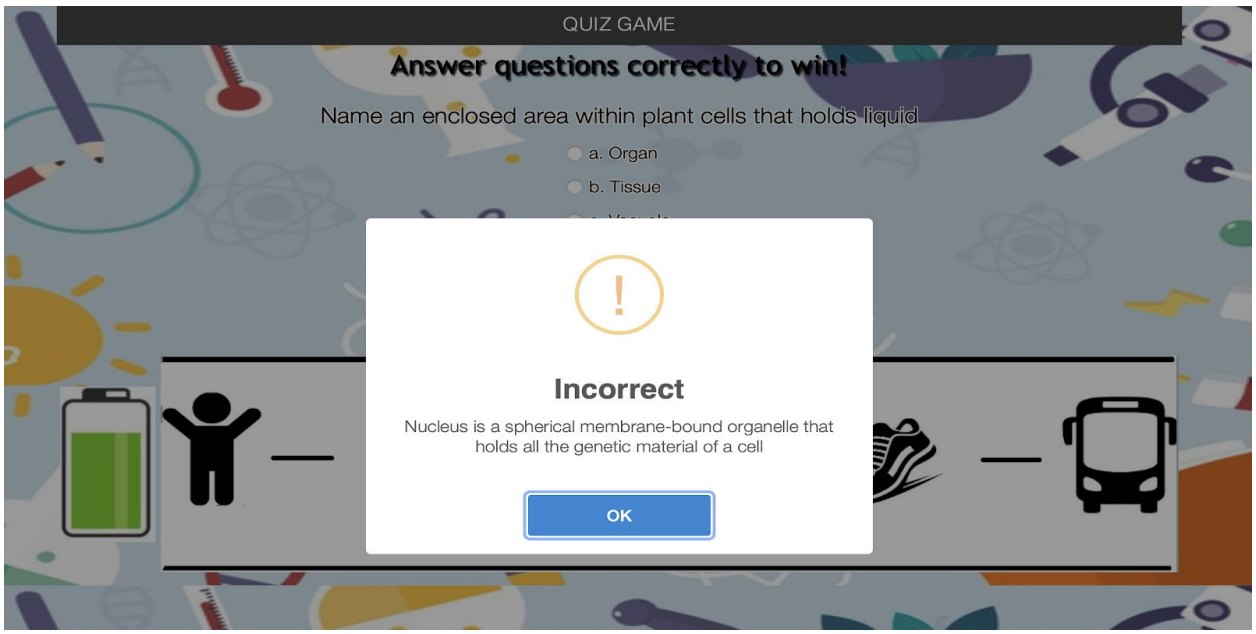
3.3.7 User story: Implement instant question feedback on quizGame.

Points: 2. Status: Complete. Description: As a player, I should be told immediately after answering a question whether my answer is correct or incorrect. The feedback should be accompanied by further explanation about the question.

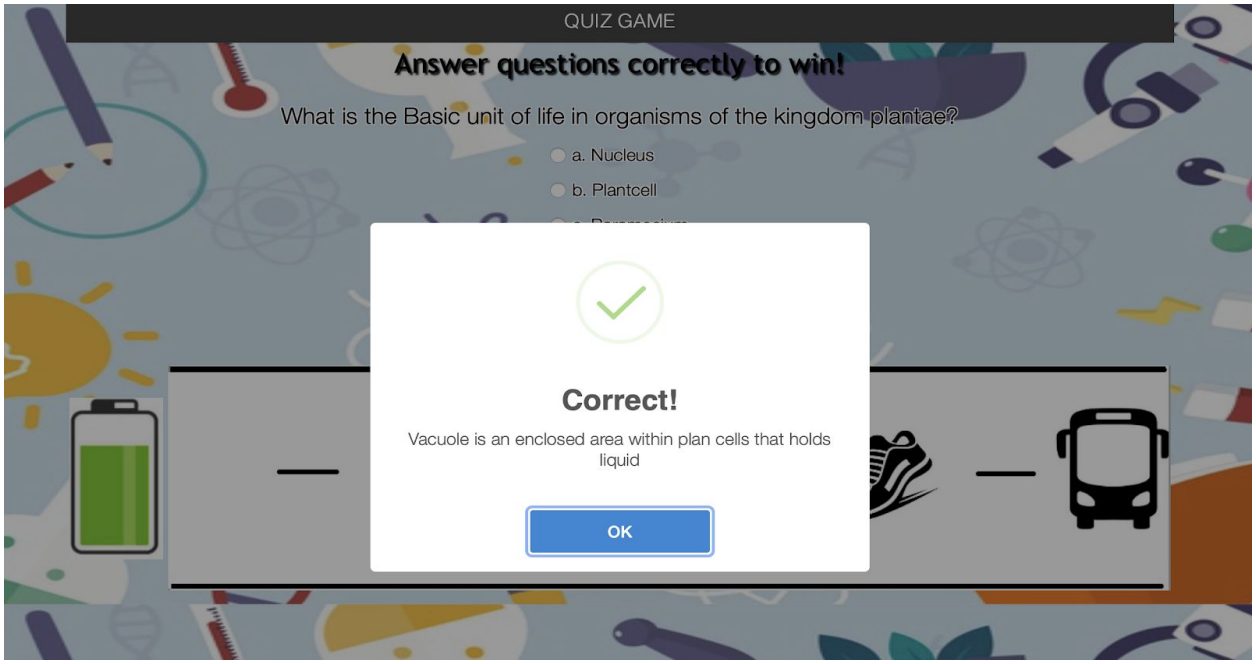
3.3.8 User story: Implement animation to display game state of quizGame.

Points: 3. Status: Complete. Description: As a player, I should see a graphic that displays my score. This graphic should update as I answer each question to reflect the correctness/incorrectness of my answer.

When the player gives an incorrect answer, a pop-up appears explaining the correct answer along with a buzzer sound. The battery level goes one level down and the player remains at the same position.



When the player selects the correct answer, a pop-up appears with the explanation and a correct audio sound. The player moves one step ahead.



3.3.9 User story: Display quizGame questions in random order.

Points: 2. Status: Complete. Description: As a player, I should not always see the same questions appear in the same order.

Everytime the new quiz game is loaded, questions should appear randomly. The order of the questions should not be the same.

3.3.10 User story: Display choices for quizGame questions in random order.

Points: 1. Status: Complete. Description: As a player, the answer choices for each question should not always be displayed in the same order.

On every load of the question , the order of the options should change.

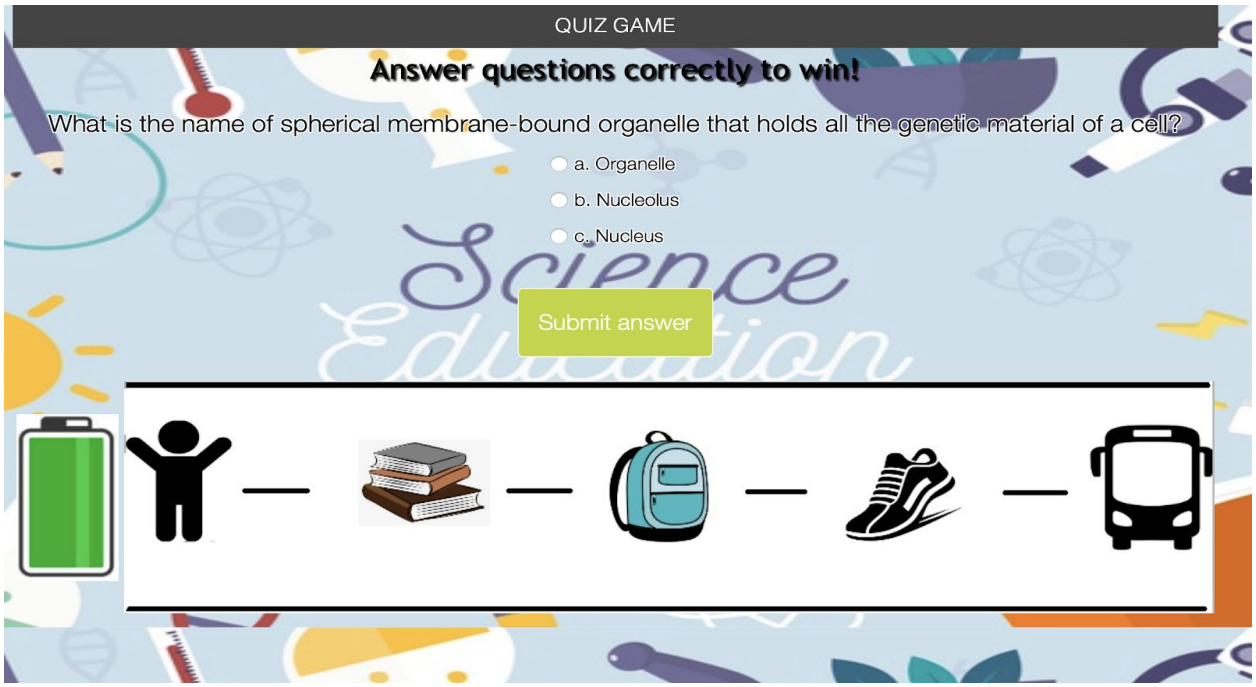
3.3.11 User story: Add outline to text.

Points: 2. Status: Complete. Description: As a player, I should see a white outline to the question text so that it can be easily read.

3.3.12 User story: Add school graphics to quizGame.

Points: 3. Status: Complete. Description: As a player, I should be able to determine my progress in the game by the number of images that remain. For each question I get correct, one of the images goes away and my player image should move forward.

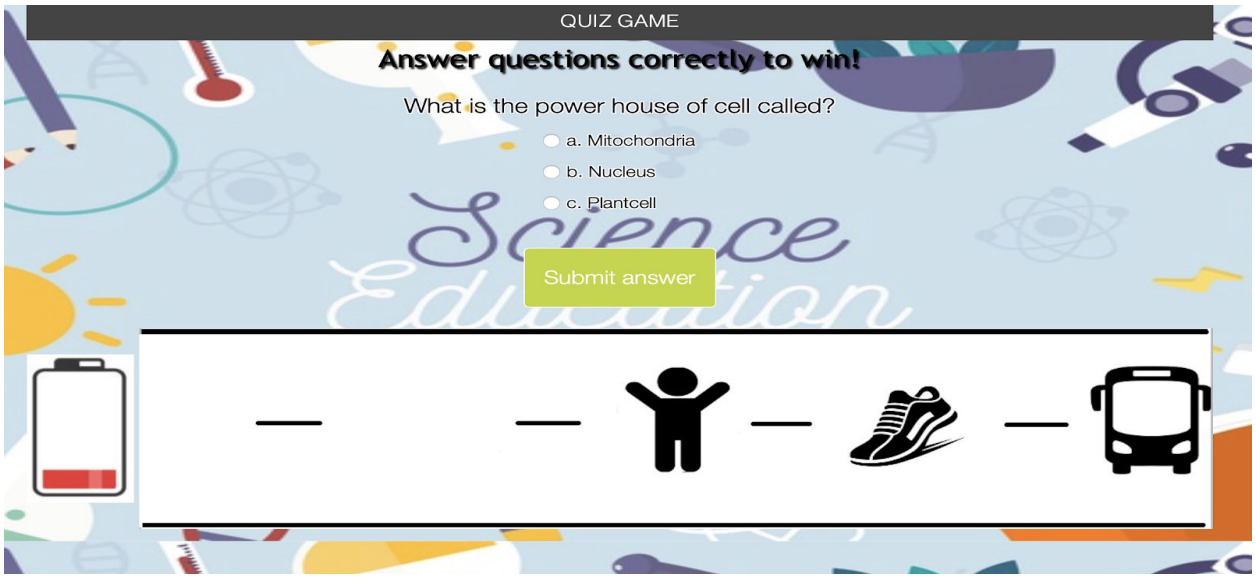
When the start button is clicked, a question appears with three options. The player has to select an answer.



3.3.13 User story: Add battery graphic and animation to quizGame.

Points: 3. Status: Complete. Description: As a player, I should be able to determine how many "lives" I have by the charge on the battery. Each time I get a question wrong, it should deplete by 1/5th of the total capacity. Once it is empty, I lose.

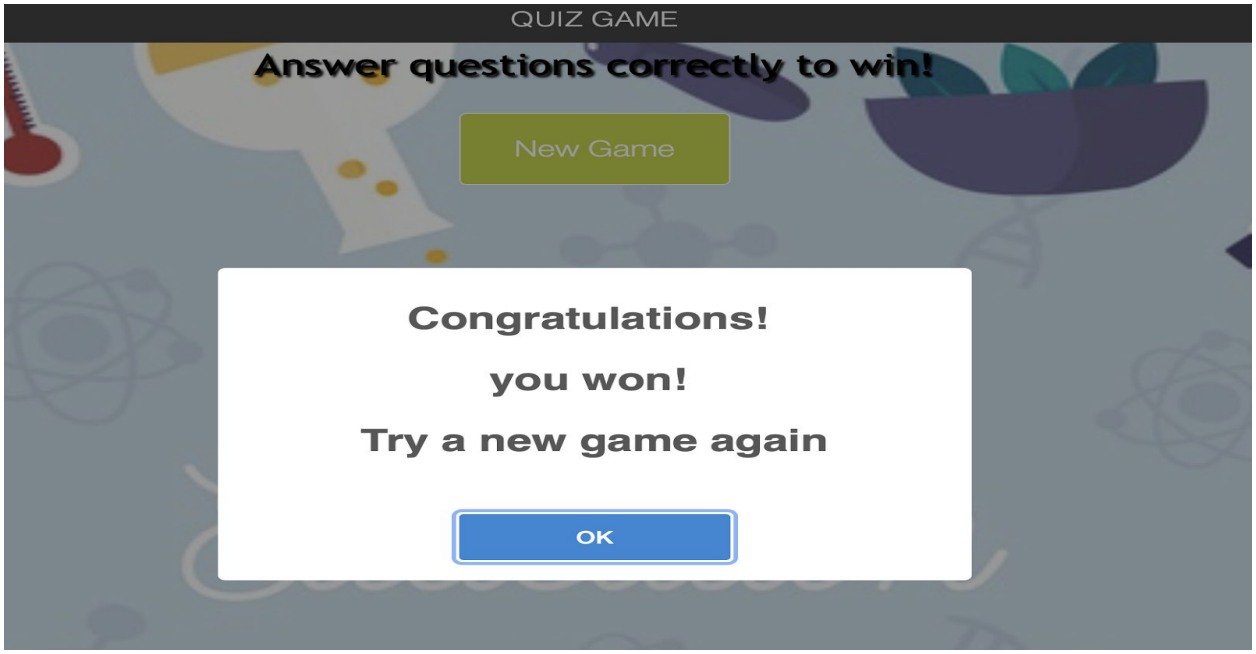
At this moment, when the battery shows red color, if the player gives any incorrect answer, he/she loses the game.



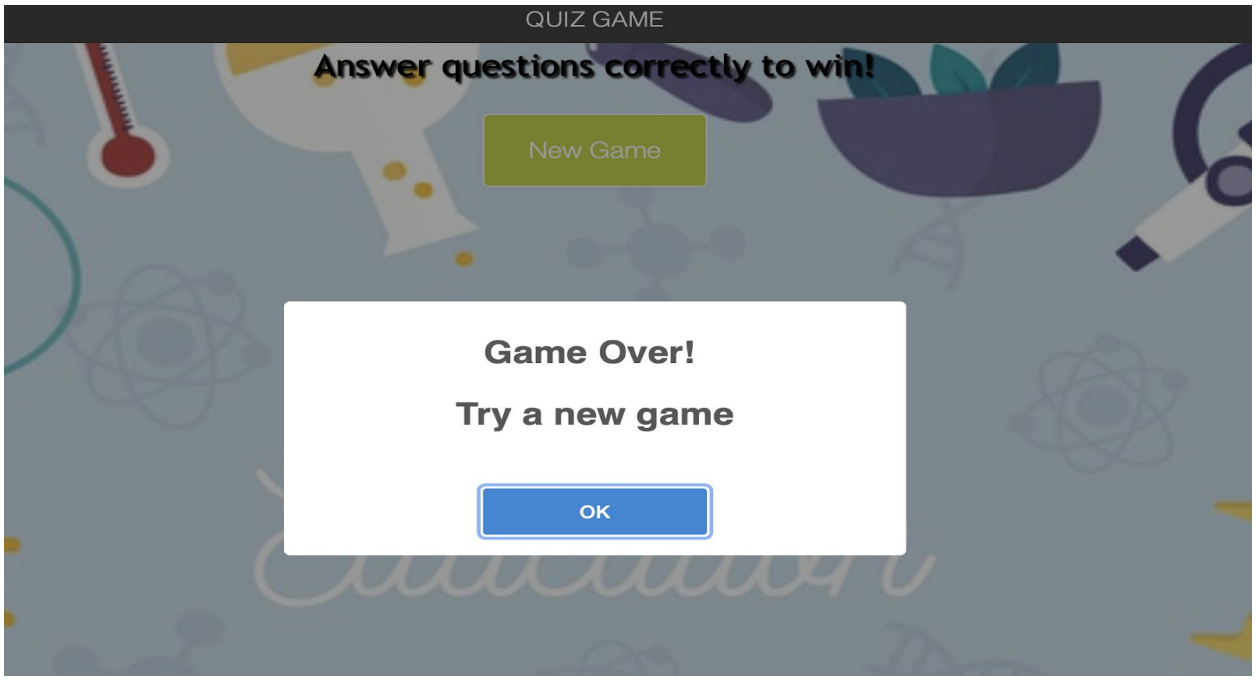
3.3.14 User story: Give feedback at the end of the game in quizGame.

Points: 2. Status: Complete. Description: As a player, I should receive a notification pop-up once the game is over. This should tell me whether I won or lost.

When the player gives correct answers and moves ahead to reach the final point at the image of the school bus, a pop-up appears showing the player has won the game.



Giving the incorrect answer, the player loses the game and a pop-up appears showing that the game is over. The player is then asked to start a new game.



3.3.15 User story: Improve game logic to quizGame.

Points: 2. Status: Complete. Description: As a player, I should win whenever I get 4 questions correct and lose whenever I get 4 questions wrong.

3.3.16 User story: Add background graphic to quizGame.

Points: 2. Status: Complete. Description: As a player, I want to see a background while I play the game.

When the Quiz game is loaded:

3.3.17 User story: Add sound to quizGame for player feedback.

Points: 2. Status: Complete. Description:

Everytime a player gives a correct or incorrect answer to a question, a sound effect is given to add an extra effect on showing whether the question is correct or incorrect. Besides that, when the player wins or loses the game , sound effects make it more fun.

4 Iterations

As mentioned previously, we followed Agile software development methodology. We created user stories that reflected the requirements of the customer and for each iteration we implemented these changes locally and updated our code repository on GitHub. Finally, we deployed our code on the StepStone environment. Work was divided among each team member during each iteration throughout the project's duration.Ultimately Pivotal tracker was updated after each iteration to reflect the changes that were implemented.

4.1 Iteration 0

Points Completed: 0.

We spent this iteration learning StepStone, creating our user stories, contacting our customer, and looking into similar legacy projects. There were some previous teams who worked specifically on the Cell Biology Module. We contacted one of the previous project teams to get a grip on this project and understand the legacy code. As mentioned earlier, on behalf of the TAMU Veterinary Medicine and Biomedical Sciences Department's work in the Peer program, Dr. Walker outlined three primary tasks for the team.

- First was to clean up the existing games *Guess-Up* and *Scramble*. He mentioned some features that were lacking in Guess Up and some unresponsiveness in the controls on Scramble. We were also encouraged to look for other potential improvements.
- Second one was to improve the content templates for Guess Up and Scramble. In particular, the template for Guess Up currently does not support images. These improvements would hopefully allow the games to be propagated across other modules in the One Health curriculum.
- Third one was to implement more games. Other than a few restrictions, Dr. Walker expressed that we have a lot of freedom in these choices. Any game should have a content template so that people working with Vet Med can easily add new content.

In addition to these tasks, Dr. Walker described that these games would be within StepStone and asked us to explore the possibility of also deploying onto the PHP based websites like *WordPress*.

4.2 Iteration 1

Points Completed: 12.

These user stories can really be partitioned into two different sets: some are focused on improving the existing games, and others are concerned with adding new games. Once we are ready to start tackling these stories, we will split the team into two groups. One group will focus on improving the old games, while the other will focus on implementing one of the new games. There were a number of points we were focusing on in this iteration which include:-

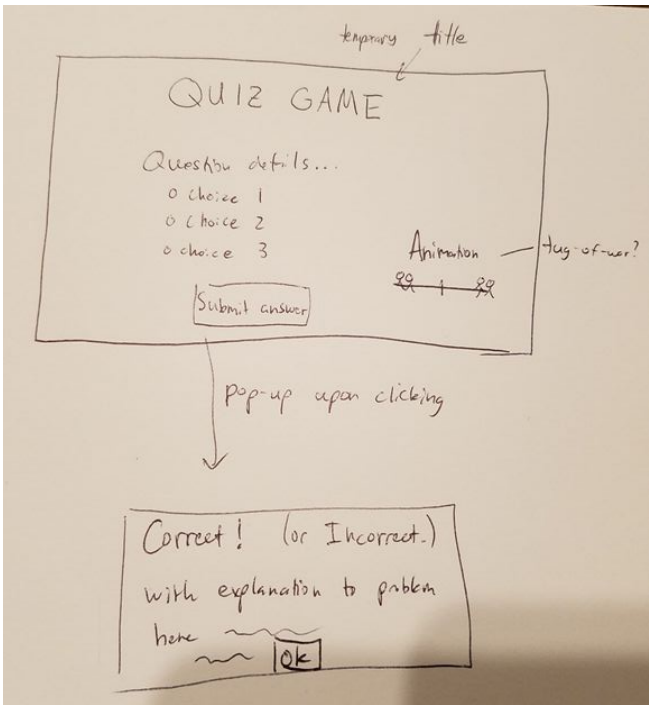
- Adding a difficulty setting to the Guess Up game. The player will be able to select from the difficulties: easy, medium, and hard, so that he/she can be given words that appropriately match their knowledge.
- Adding randomness to the GuessUp game. The earlier version had a fixed order of questions and they repeated in the same fashion every time spawned. This was changed in this iteration where we added randomness to that ordering.
- In the previous GuessUp version the number of lives that a player can have was fixed on 10 lives which was too much for a small name. So, to make the game more interesting we introduced dynamic lives for the player.
- Another addition to the features we had was for Scramble where we removed the text selection cursor on tiles. This small change added on the user experience a lot. As a player it would be very irritating to see the text cursor when clicking or dragging the tiles. This was changed in this iteration for better UX.
- The tile size for each letter in the Scramble game were of different sizes. This was not something which is expected when designing the game. So, in this iteration we changed the tile size for each letter to be uniform. This feature was mainly added to enhance the UX.
- While playing the Scramble game for multiple times it was observed that we could move the tiles in any position on the screen which again made the experience of the user bad. So, the movement of each tile was restrained for horizontal movements only.

4.3 Iteration 2

Points Completed: 6.

The main work in this iteration went into designing and working on a new game called quizGame. This game is like a questionnaire with some interesting animations for each question. The whole designing was first done using a UI mockup and then many basic steps were taken so as to implement the core logic system behind the game. The design was tried to implement using html and css alone and the logic part was done on javascript. The detailings of work are as follows:-

- The designing was done at first using UI mockups as shown in the figure below.



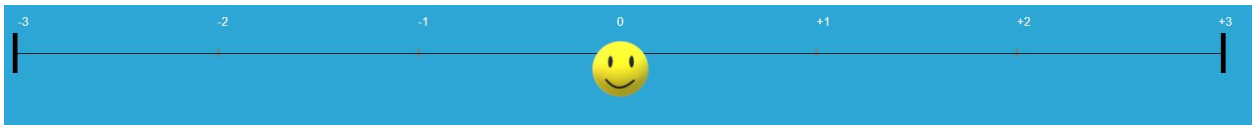
- Implemented multiple choice question interface for quizGame. This included the basic frame and structure of how the game will look. This formed the basis of the game from a very early phase. The players will be able to see the questions and their multiple options and select from one of them.
- The next task included making these questions set visible per page and not all at once. This added on quite a bit of work and also enhanced the UI. When switching to one question per page there were many challenges on how to break down the code which took quite a bit of time.
- The next task mainly included adding code for displaying the results at the end of the game. This included showing the number of correct answers and incorrect answers. The details about which questions were answered incorrectly were also shown at the end.
- The UI at first was not that intuitive for the player but was changed a bit to enhance UX. This was done with many formatting and designing options that html and css provides.
- For the testing purposes Jasmine was set up in this iteration. This framework allows many testing ways and runs on any JavaScript-enabled platform. This made it favourable for our project.
- Different sections of code were also restructured in different files and folders in this iteration so as to maintain cleanliness in the codebase.

4.4 Iteration 3

Points Completed: 8.

This iteration mainly focused on adding more functionalities in quizGame and animations as a means of scoring system. The data section was also separated in this iteration. After the work in this iteration was done we were in a position to go for an initial deployment session. The details of this iteration are as follows:-

- Content template was implemented for quizGame. Basically, the data section in the previous code was inside the javascript file itself along with the game logic which is not a good way to write softwares. So, in this iteration the game data was separated and kept in a new file named game_data.js.
- The scoring system and win/loss logic was developed in this iteration. This was a pivotal step in making the game as there is actually no sense of game without any scoring system in general.
- The implementation of instant question feedback system was also done in this iteration. As a player it should be told immediately after answering a question whether the answer is correct or incorrect. The feedback will be accompanied by further explanation about the question.
- Implementation of basic animation to display the status of the game was added here. The graphic used for this was a simple smiley jumping from here and there in a number line. It got updated by moving forward when the player gave the correct answer and moving backward on incorrect ones.



- As we saw in earlier iterations that adding randomness in the order of questions is an important step. So, we implemented a random picking system for the quizGame too.
- Similarly, the answer choices were in a fixed order every time they spawned. So, the next step was to implement a random ordering for these multiple choices of each question. This was an easy step which was implemented using the same code snippet from the previous step.

4.5 Iteration 4

Points Completed: 10.

This iteration had a great focus on the deployment part. The whole team was mainly looking forward to the FTP and the main server deployment. Also, there were many small but impactful bug fixes that were to be done. All this was done in this iteration. The list of tasks are listed down below:-

- Addition of sound effects for every correct and incorrect answers and win/loss position in the quizGame. Sound effects make a game much more interesting and touching. This simple but effective change made the game better for children.
- The background graphic was also added in this iteration. Although the background image display had some initial issues of image repeating throughout the screen but was later on fixed to a single image stretching to the whole screen. It was just another small but impactful change to enhance the UI.
- There was another improvement to the game logic on win/loss. Now, the player can only give 5 incorrect answers. Also, if the player gives 5 correct answers before getting 5 incorrect ones he wins the game.
- The pop-up culture introduced in other games inspired us to make pop-ups for win/loss situations too. So, now whenever a player wins or loses the game he/she is shown a notification for the same and then a button to replay the game.
- The animation step was the main breakthrough that we got in this iteration. The animation for the child moving ahead on a road to school for correct answers. These small animations make the whole game a great fun.
- Another part of the animation was on depleting the battery when the player gives incorrect answers. This was in relation to the previous animation thought. As the battery level goes down the player goes in losing position.
- There was one more main UX point that was taken into account in this iteration. The text of questions and answers were not visible sometimes due to their color matching the background. This was treated using a white highlight in the texts which added on the UX.
- Add a point for adding data sections for other modules.

5 Customer Meetings

- **September 29th, 2020, 10:00 A.M.:** This meeting occurred for *iteration 0* and we received an overview of the project. We were told to focus on adding at most 1-2 new games. We were given some feedback on the nature of the games for instance we were advised to add engaging animations, more difficulty choices in the game, give explanations to the correct and incorrect answers, and provide progressive hints. Some suggested improvements to old games were given, such as: improve responsiveness in Scramble and explore (and add to) content template for both existing games. We were encouraged to add any other new features that we think would be appropriate. We were given the goal to eventually deploy to modules other than Cell Biology.
- **October 19th, 2020, 1:00 P.M.:** This meeting occurred for *iteration 1* and we received positive feedback on our improvements to previous games. We were encouraged to start a new game, and we brainstormed ideas for such a game.
- **October 26th, 2020, 1:00 P.M.:** This meeting occurred for *iteration 2* and we gave a demo for the first iteration of quizGame. We were told to prioritize two features: give students instant feedback on each question and make an animation showing the game state.
- **November 18th, 2020, 1:00 P.M.:** This meeting occurred for *iteration 3* and discussed the progress we made on the animations. We gave a demo of the next iteration of the *Quiz Game*. We were given feedback to improve the usability of the game by making the text more readable. We were also told to collect data for other modules for each of the three games. Dr. Walker also gave us feedback on the final report and the final video demo/poster presentation. He suggested we should prepare a report by keeping in mind of the next group that might pick up our project. Hence, he suggested that we add a tutorial section specifically for deployment of the code.

6 Issues

- **Deployment on Stepstone**:

Tutorial provided for deploying our game to Stepstone was out of date as it did not have latest changes. It was only after talking to the previous team we came to know about the latest procedure for deployment. As these changes were not documented anywhere and we were following an old tutorial for our deployment, we faced issues in the procedure which took us time to resolve. Lastly we have been able to deploy our games on Stepstone and also we have documented the latest steps for deployment in Section 9 of this report.

- **Testing Legacy Code with Jasmine :**
  Previous team has not done any unit testing with Jasmine. In iteration 1 we started with exploring Jasmine for unit testing of legacy code which took time as it required integration of legacy code with the jasmine environment. However, we did not proceed with the complete testing as that required writing test cases for the legacy code from scratch. As customer priority was more on development of a new game, we decided to proceed with the development part instead of unit testing legacy code.
- **Animation rescaling:**
  For our quiz game scoreboard, initially we implemented a tug of war styled animation in iteration 3. But we faced several issues related to resizing of this animation with dynamic change in screen size as this animation has several components and synchronization of step size and relative size of each of these components appeared to be cumbersome. Moreover, the animation did not go well with the game appearance. So we came up with another animation which is implemented using superimposition of several images for different scores and easily rescales with dynamic change in screen size.

7 Legacy

7.1 Prior code

As a team we had concerns regarding learning JavaScript, jQuery, and learning how to deploy on StepStone. Hence understanding and learning the legacy code was important. We used the following legacy code repository which contained the work done related to the Cell Biology Module and Stress Module. These repositories were useful and gave us a primary idea of the

animation and documentation for setting up a jQuery application with StepStone as well as the slides related to biology made with HTML, CSS, JavaScript, and jQuery. The use of "iframeResizer.contentWindow.min.js" for enabling JS application resizing is crucial for compatibility with StepStone. Also, the previous team's documentation on detailed instructions deployment was helpful.

7.2 New code reconfiguration

After we were done with understanding the legacy code we started off working on our new game application using the tools and knowledge we got from reading the legacy code. In the initial phases of development we made a basic structure in HTML and CSS. Then we made a javascript file for the basic logic behind the quiz game without any formatting and only texts. The code structure was then divided into initialization of variables at the top which included defining handlers, sound handlers and button controllers. The game starts off with a start function in the javascript file where all the initial objects are spawned and other useful frames are loaded. There are other functions for specific tasks like displaying questions, checking answers, handling different parts of an animation and ending the game. They are called from this start function at the beginning where each of these are seen in a loop fashion. To have a good balance, all the data related to the game application is stored in a different file called game_data.js. This contains all the questions. answers and hints. This was inspired from the previous games where the data section was isolated. This is usually a good practice to follow as for a non-developer it would be very easy to change the data from that file only.

8 Logistics

8.1 Team Roles

Product owner: *Venkata Sameer Kumar Betana Bhotla*

Scrum master: *John Griffin*

Rest of the team: *Darakshan Anwar, Rohit Jain, Nimoshika Jayaraman, Tanu Shree*

8.2 Project resource link

***StepStone developer**: Daniel Shuta, dshuta@cvm.tamu.edu*

Pivotal Tracker: https://www.pivotaltracker.com/n/projects/2467325

GitHub: https://github.com/JainRohitLive/CellBiologyLearningGames

Project Poster Demo:

Project Video Demo:

TAMU Vetmed One health modules: https://vetmed.tamu.edu/peer/one-health/

9 Tutorials on Deployment on StepStone

The deployment phase starts with testing your app on stepstone. All the details regarding this can be found here on Page 15 i.e. Tutorial 2. After we observe that the game is working fine on stepstone, we move on to deployment on FTP server.
For deployment on FTP servers there are a number of steps that need to be followed. As shown in Figure 1, the desired game(in this case quizGame) should be placed in the indicated directory. After which there are a number of changes that need to be made in the json files inside the json directory of practice_c1. The first change includes adding a new draggybox json file for your game(in our case draggybox44.json) with the contents same as other draggybox json files with minor changes which are shown in Figure 3 and 4. After this some changes need to be made in the structure.json file in the same folder which are shown in Figure 5, 6 and 7.

Once the games have been deployed to the FTP server and successfully tested and verified, the deployment to the main production server can begin. For this we will need to contact Daniel Shuta (dshuta@cvm.tamu.edu), our main contact for the purpose of deployment from the stepstone system (since we don't have direct access to the deployment server). We will need to provide all the below fields to Dan for him to deploy our apps into the production server. The following details are needed to deploy.

- **Module ID**: This is the module ID present in the main stepstone authoring system. This can be found under the course packager application of the stepstone authoring system. For our project this was " SEPACellBio ".

- **Path ID**: This is the path ID that is found under the module. This can also be found under the course packager application of the stepstone authoring system inside your module. You will need to give both the module ID on the FTP server and the production server to which you want to deploy to perform a successful deployment. For us it was "Practice_Cells1" in the prod server, "practice_c1" in the FTP server.
- **Step ID**: This is id referring to the individual steps inside the path of the module that your games are ultimately present in. This is determined by the id that you have on the stepstone environment. For our project it was 44 in the FTP server and 45 on the production server.

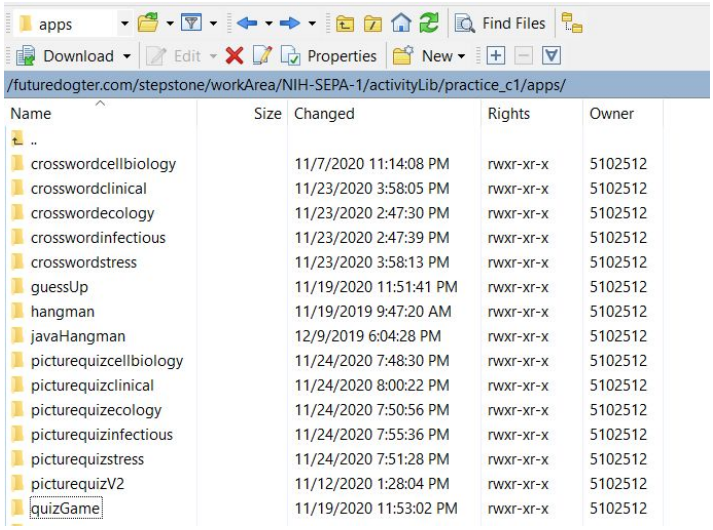


Figure 1

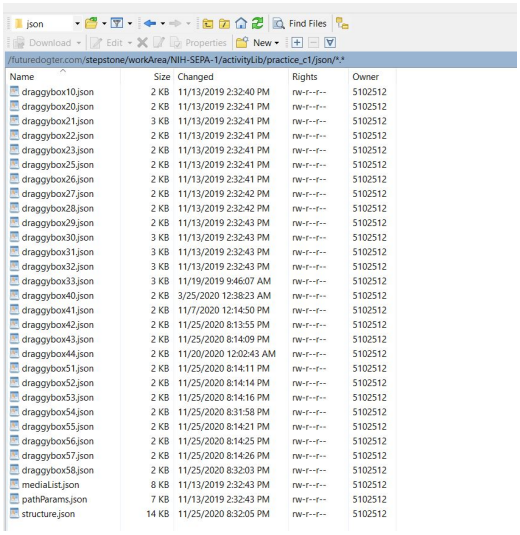


Figure 2

```
{
	"nodeContent" : {
		"content" : {
			"title" : "Quiz Game",
			"text" : "",
			"media" : [
				{
					"role" : "BgBase1",
					"type" : "Image",
					"variant" : "Basic",
					"repeat" : "no-repeat",
					"position" : "center center",
					"bgsize" : "cover",
					"display" : ""
				}
			],
			"miniApps" : [
				{
					"role" :		"MainSandbox1",
					"type" :		"Custom",
					"variant" :	"Basic",
					"launched" :	"quizGame",
					"apiSet" :		"Basic",
					"maxW" :		"Auto",
					"minH" :		"Auto",
					"maxH" :		"Auto",
					"caption" :	""
				}
			]
		},
		"type" : "MiniApp",
		"variant" : "Basic",
		"theme" : "Basic",
		"options" : {
			"ImageHPosition" : "Left",
			"ImageVPosition" : "Top",
			"ImageW" : "35",
			"ImageStaticToggle" : "On",
			"ImageZoomToggle" : "On",
			"TextStyle" : "PageWidth",
			"ImageFraming" : "Default"
		}
```


Figure 3


```
			"ImageVPosition" : "Top",
			"ImageW" : "35",
			"ImageStaticToggle" : "On",
			"ImageZoomToggle" : "On",
			"TextStyle" : "PageWidth",
			"ImageFraming" : "Default"
		}
	},
	"nodeAssessment" : {
		"type" : "Pass Through",
		"variant" : "Basic",
		"theme" : "Basic",
		"shuffle" : "false",
		"outputs" : [
			{
				"cid" : "1",
				"outputStatus" : "Neutral",
				"outputBehavior" : "Step Forward",
				"text" : "",
				"targetNode" : "2"
			}
		]
	},
	"nodeAuthoringData" : {
		"stepNotes" : ""
	}
}
```


Figure 4


```
		"44"
	],
	"idealPath" : [
		"1",
		"3",
		"5",
		"30",
		"7",
		"8",
		"9",
		"32",
		"25",
		"20",
		"26",
		"27",
		"31",
		"28",
		"29",
		"21",
		"22",
		"23",
		"33",
		"40",
		"41",
		"42",
		"51",
		"52",
		"53",
		"54",
		"55",
		"56",
		"57",
		"58",
		"43",
		"44",
		"2"
	],
	"nodeMapUnits" : [
```


Figure 6


```
	"nodeMap" : {
		"stasis" : {
			"currentNodeSelection" : "33"
		},
		"nodeDrawOrder" : [
			"3",
			"7",
			"8",
			"20",
			"26",
			"28",
			"29",
			"21",
			"22",
			"2",
			"1",
			"5",
			"27",
			"25",
			"9",
			"23",
			"30",
			"32",
			"31",
			"33",
			"40",
			"41",
			"42",
			"51",
			"52",
			"53",
			"54",
			"55",
			"56",
			"57",
			"43",
			"44"
		],
		"idealPath" : [
```


Figure 7


```
		"stepTitle" : "Picture Game - Cell Biology
	},
	{
		"nodeID" : 44,
		"nodeType" : "Default",
		"nodeStatus" : "Ideal",
		"nodeCompletionStatus" : "Default",
		"authorCommentsPresent" : false,
		"xPoz" : 800,
		"yPoz" : 300,
		"outputs" : [
			{
				"id" : 2,
				"method" : "StepForward"
			}
		],
		"nodeLabel" : "Quiz Game",
		"stepTitle" : "Quiz Game"
	}
```


Figure 5